AMENDMENTS TO THE CLAIMS

1. (Previously Presented) A method of measuring at least one selected parameter at a location within a region of interest, which method comprises the steps of:

launching optical pulses at a plurality of preselected interrogation wavelengths into an optical fiber deployed along the region of interest, reflectors being arrayed along the optical fiber to form an array of sensor elements, the optical path length between the said reflectors being dependent upon the selected parameter;

detecting the returned optical interference signal for each of the preselected wavelengths; and

determining from the optical interference signal the absolute optical path length between two reflectors at the said location, and from the optical path length so determined the value of the selected parameter at the said location.

2. (Currently amended) ~~A method as claimed in claim 1~~ A method of measuring at least one selected parameter at a location within a region of interest, which method comprises the steps of:

launching optical pulses at a plurality of preselected interrogation wavelengths into an optical fiber deployed along the region of interest, reflectors being arrayed along the optical fiber to form an array of sensor elements, the optical path length between the said reflectors being dependent upon the selected parameter;

detecting the returned optical interference signal for each of the preselected wavelengths; and

determining from the optical interference signal the absolute optical path length between two reflectors at the said location, and from the optical path length so determined the value of the selected parameter at the said location,

wherein the step of determining the absolute optical path length comprises carrying out a process in which the derivative of the phase as a function of wavelength is estimated from a subset of the interference signals, using the derivative and an estimated value for the optical path length to estimate the phase relationship between the interference signals, and the phase

relationship thus obtained is used to revise the estimated value for the optical path length, the process being repeated for increasing subsets of the remaining wavelengths in sequence, on the basis of the optical path length estimated for the immediately preceding subset in the sequence, thereby to progressively revise the optical path length until it is known to a desired level of accuracy.

Claim 3 (Canceled)

4. (Previously Presented) A method as claimed in claim 1, wherein said optical fiber comprises polarization-maintaining fiber and light is launched into the fiber in such a way that the power of the light signal is substantially equally divided between the orthogonally-polarized propagation modes of the fiber, thereby to interrogate each principal state of polarization of the fiber simultaneously, the return interference signals from both principal states of polarization being used separately in the said process for determining the absolute optical path length for each propagation mode independent of the other mode.

5. (Previously Presented) A method as claimed in claim 1, wherein the optical fiber comprises polarization-maintaining fiber and light is launched into the fiber in such a way that the power of the light signal is firstly directed entirely into one of the principal states of polarization and then the other, thereby to interrogate the principal states of polarization sequentially, the returned interference signals from both principal states of polarization being used separately in the said process for determining the absolute optical path length for each propagation mode independent of the other mode.

6. (Previously Presented) A method as claimed in claim 1, in which the selected parameter comprises temperature.

Claims 7-9 (Canceled)

10. (Previously Presented) A method as claimed in claim 1, in which the selected parameter comprises strain.

11. (Previously Presented) A method as claimed in claim 10, wherein the optical fiber is a high-birefringence fiber, the birefringence of which changes in response to strain applied to the optical fiber.

12. (Previously Presented) A method as claimed in claim 11, wherein the birefringence of the high-birefringence fiber also changes in response to temperature, and the method further comprises compensating the returned optical interference signal for effects arising from temperature at the said location.

Claim 13 (Canceled)

14. (Previously Presented) A method as claimed in claim 1, in which the selected parameter comprises pressure.

15. (Previously Presented) A method as claimed in claim 14, wherein the said optical fiber comprises a side-hole fiber.

16. (Previously Presented) A method as claimed in claim 15, wherein each sensor element of the fiber is located within a sealed elliptical tube filled with a pressure-transmitting fluid.

Claims 17-18 (Canceled)

19. (Previously Presented) A method as claimed in claim 1, wherein the selected parameter depends on a localized event moving along the region of interest, and the method comprises determining the value of the selected parameter over time at more than one said location, and

determining the movement of the localized event from the determined values of the selected parameter.

20. (Previously Presented) A method as claimed in claim 19, wherein the localized event is a user-induced event, and the method further comprises inducing the localized event.

21. (Previously Presented) A method as claimed in claim 19, wherein the localized event is a volume of fluid within the region of interest that has a different temperature, pressure, or density from surrounding fluid in the region of interest, the selected parameter being temperature, pressure, or density, respectively.

22. (Previously Presented) A method as claimed in claim 1, wherein at least two selected parameters are measured simultaneously.

Claims 23-25 (Canceled)

26. (Previously Presented) A method as claimed in claim 1, wherein the measured value for the parameter is used to determine the value for a further measurand dependent upon the said parameter and wherein the said optical fiber is provided with a coating which responds to the said further measurand by stretching or shrinking.

Claim 27 (Canceled)

28. (Previously Presented) A method as claimed in claim 26, wherein the said coating is electro-strictive.

29. (Previously Presented) A method as claimed in claim 26, wherein the said coating is magneto-strictive.

30. (Previously Presented) A method as claimed in claim 26, wherein the said coating is sensitive to a selected chemical measurand.

Claims 31-35 (Canceled)

36. (Previously Presented) A method according to claim 1, wherein the region of interest lies within an oil well.

Claims 37-38 (Canceled)

39. (Previously Presented) Apparatus for measuring a selected physical parameter at a location within a region of interest, which apparatus comprises:

an optical fiber for deployment along the region of interest, the optical fiber having reflectors therealong forming an array of sensor elements, the optical path length between the said reflectors being dependent upon the selected parameter;

source means operable to launch optical pulses at a plurality of preselected interrogation wavelengths into the said fiber;

signal detection means operable to detect the returned optical interference signal for each of the preselected wavelengths; and

signal processing means operable to determine from the optical interference signal the absolute optical path length between two reflectors at the said location and to determine from the optical path length so determined the value of the selected parameter at the said location.

40. (Currently Amended) ~~Apparatus as claimed in claim 39~~ Apparatus for measuring a selected physical parameter at a location within a region of interest, which apparatus comprises:

an optical fiber for deployment along the region of interest, the optical fiber having reflectors therealong forming an array of sensor elements, the optical path length between the said reflectors being dependent upon the selected parameter;

source means operable to launch optical pulses at a plurality of preselected interrogation wavelengths into the said fiber;

signal detection means operable to detect the returned optical interference signal for each of the preselected wavelengths; and

signal processing means operable to determine from the optical interference signal the absolute optical path length between two reflectors at the said location and to determine from the optical path length so determined the value of the selected parameter at the said location,

wherein the said signal processing means is operable to determine the absolute optical path length by carrying out a process in which the derivative of the phase as a function of wavelength is estimated from a subset of the interference signals, using the derivative and an estimated value for the optical path length to estimate the phase relationship between the interference signals, and the phase relationship thus obtained is used to revise the estimated value for the optical path length, the process being repeated for increasing subsets of the remaining wavelengths in sequence, on the basis of the optical path length estimated for the immediately preceding subset in the sequence, thereby to progressively revise the optical path length until it is known to a desired level of accuracy.

Claim 41 (Canceled)

42. (Previously Presented) Apparatus as claimed in claim 39, wherein the said optical fiber comprises polarization-maintaining fiber, and the apparatus further comprises power launching means operable to launch the optical pulses into the fiber in such a way that the power of the optical pulses is substantially divided between the orthogonally-polarized propagation modes of the fiber, thereby to interrogate each principal state of polarization of the fiber simultaneously; and the signal processing means being operable to use the returned optical interference signals from both principal states of polarization separately to determine the absolute optical path length for each propagation mode independent of the other mode.

43. (Previously Presented) Apparatus as claimed in claim 39, wherein the said optical fiber comprises polarization-maintaining fiber, and the apparatus further comprises a polarization modulator operable to launch the optical pulses into the fiber in such a way that the power of the optical pulses is firstly directed entirely into one of the principal states of polarization of the fiber and then the other, thereby to interrogate the principal states of polarization sequentially; and the signal processing means being operable to use the returned optical interference signals from both principal states of polarization separately to determine the absolute optical path length for each propagation mode independent of the other mode.

44. (Previously Presented) Apparatus as claimed in claim 39, wherein the parameter comprises temperature.

Claims 45-47 (Canceled)

48. (Previously Presented) Apparatus as claimed in claim 39, wherein the parameter comprises strain.

49. (Previously Presented) Apparatus as claimed in claim 48, wherein the optical fiber is a high-birefringence fiber, the birefringence of which changes in response to strain applied to the optical fiber.

50. (Previously Presented) Apparatus as claimed in claim 49, wherein the birefringence of the high birefringence fiber also changes in response to temperature, and the signal processing means is further operable to compensate the returned optical interference signal for effects arising from temperature at the said location.

Claim 51 (Canceled)

52. (Previously Presented) Apparatus as claimed in claim 39, wherein the parameter comprises pressure.

53. (Previously Presented) Apparatus as claimed in claim 52, wherein the said optical fiber comprises a side-hole fiber.

54. (Previously Presented) Apparatus as claimed in claim 53, wherein each sensor element of the fiber is located within a sealed elliptical tube filled with a pressure-transmitting fluid.

Claims 55-56 (Canceled)

57. (Previously Presented) Apparatus according to claim 39, wherein the selected parameter depends on a localized event moving along the region of interest, and the signal processing means is operable to determine the value of the selected parameter over time at more than one said location, and to determine the movement of the localized event from the determined values of the selected parameter.

58. (Previously Presented) Apparatus according to claim 57, wherein the localized event is a user-induced event.

59. (Previously Presented) Apparatus according to claim 58, wherein the localized event is a volume of fluid within the region of interest that has a different temperature, pressure, or density from surrounding fluid in the region of interest, the selected parameter being temperature, pressure, or density, respectively.

60. (Previously Presented) Apparatus as claimed in claim 39, and further for measuring a second selected physical parameter at the location within the region of interest, wherein said optical path length between the said reflectors is further dependent upon the second selected

parameter; and the signal processing means is further operable to determine the value of the second selected physical parameter from the determined absolute optical path length.

Claims 61-63 (Canceled)

64. (Currently Amended) Apparatus as claimed in claim [[61]] 39, operable to use the measured value for the parameter to determine a value for a further measurand dependent upon said parameter, and wherein the said optical fiber is provided with a coating which responds to the said further measurand by stretching or shrinking.

Claim 65 (Canceled)

66. (Previously Presented) Apparatus as claimed in claim 64, wherein the said coating is electro-strictive.

67. (Previously Presented) Apparatus as claimed in claim 64, wherein the said coating is magneto-strictive.

68. (Previously Presented) Apparatus as claimed in claim 64, wherein the coating is designed to be sensitive to a selected chemical measurand.

69. (Previously Presented) Apparatus as claimed in claim 39, wherein the source means are operable to launch light at a fixed wavelength and at a varying wavelength into the fiber, and the signal processing means are operable to use the interference signal from interrogation at the fixed wavelength to determine high frequency phase changes.

70. (Previously Presented) Apparatus as claimed in claim 69, further comprising an auxiliary optical fiber for deployment through the region of interest, reflectors being arrayed along the

fiber to form an auxiliary array of sensor elements, the source means being operable to launch the fixed wavelength signal into the auxiliary fiber.

71. (Previously Presented) Apparatus as claimed in claim 70, where the auxiliary fiber has a coating designed to enhance acoustic sensitivity.

72. (Previously Presented) Apparatus as claimed in claim 69, wherein the signal processing means are further operable to use the high frequency phase changes to correct for dynamic errors in the returned optical interference signals.

73. Canceled.

74. (Previously Presented) Apparatus according to claim 39, wherein the region of interest lies within an oil well.

Claims 75-76 (Canceled)

77. Canceled.